A Synopsis of the proposed thesis entitled,

"Study of B-Snake based lane detection and tracking Mechanism using Canny Hough Estimation of Vanishing Points algorithm"

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1. Abstract:

In this Research work we study B-Snake based lane detection and tracking mechanism using robust CHEVP (Canny/Hough Estimation of Vanishing Points) algorithm without using cameras as compared with other lane models. The B-Snake based lane model is able to describe a wider range of lane structures since B-Spline can form any arbitrary shape by a set of control points. The problems of detecting both sides of lane markings (or boundaries) have been merged here as the problem of detecting the mid-line of the lane, by using the knowledge of the perspective parallel lines. Furthermore, a robust algorithm, as CHEVP and Similar Algorithm, is presented for providing a good initial position for the B-Snake. Also, a minimum error method by Minimum Mean Square Error (MMSE) is proposed to determine the control points of the B-Snake model by the overall image forces on two sides of lane. However, in the research we extend our lane model to 3D lane model by just simply adding in one more components for control points to describe the hill-dale geometry of road. For initializing the 3D lane model, the CHEVP algorithm has to be improved to meet the 3D lane model requirement. In order to improve the lane detection, also we study the effect of color, texture, saturation, reflectance data from the laser scanner and environmental conditions.

2. Introduction

With the rapid raise of urban traffic, the traffic safety becomes more and more significant. Leaving the lane causes about 30% of all accidents in the highway, and most of these are resulted from the distraction and fatigue of the driver. Therefore, a system that could provide a warning to drivers of a danger has a great potential to save a large number of lives. Systems that are designed to help the driver in its driving process are known as advanced driver assistance systems (ADAS). Many systems like adaptive cruise control, collision avoidance system, night vision, blind spot detection and traffic sign detection are a part of ADAS. Lane departure system is also a part of this category. The objective of this system is to detect the lane marks and to assist the driver, in case the vehicle has a tendency to leave the lane.

Autonomous Guided Vehicles (AGV) have found many applications in the industries. Their applications had been explored in areas, such as patient transportation in hospitals, automated warehouses and other hazardous related areas. In most applications, these AGVs have to navigate in the unstructured environments. Path findings and navigational control under these situations are usually accomplished from the images captured by camera mounted on the vehicles. These images are also interpreted to extract meaningful information such as positions, road markings, road boundaries, and direction of vehicle's heading. Among many extraction methods, the lane marking (or road boundary) detection from the road images had received great interest. As the captured images are usually corrupted by noises, lots of boundary-detection algorithms have been developed to achieve robustness against these noises.

The main properties that the lane marking (or boundary) detection techniques should possess are:

- The quality of lane detection should not be affected by shadows, which can be cast by trees,

buildings, etc.

- It should be capable of processing the painted and the unpainted roads.
- It should handle the curved roads rather than assuming that the roads are straight.
- It should use the parallel constraint as a guidance to improve the detection of both sides of lane markings (or boundaries) in the face of noises in the images.
- It should produce an explicit measurement of the reliability of the results obtained. Here we present a new B-Snake based lane detection and tracking CHEVP algorithm for the outdoor application of AGV. The main characters of our method are the following:

A novel B-Snake based lane model which describes the perspective effect of parallel lines is constructed with dual external forces for generic lane boundary or marking, it is able to describe a wider range of lane structures than other lane models such as straight and parabolic models. In addition, it is robust against shadows, noises, etc. due to the use of the parallel knowledge of roads on the ground plane. The lane detection problem is formulated by determining the set of lane model control points.

A robust algorithm called Canny/Hough Estimation of Vanishing Points (CHEVP) is presented for providing a good initial position for the B-Snake lane model. This algorithm is robust to noises, shadows, and illumination variations in the captured road images, and is also applicable to both the marked and the unmarked, dash paint line and solid paint line roads. Using Gradient Vector Flow (GVF) to construct the B-Snake external force field for lane detection, a minimum error method called Minimum Mean Square Error (MMSE) that finds the correspondence between B-Snake and the real edge image is presented to determine the parameters of road model iteratively. Road tracking is carried on after successful lane detection, by a simple external force field and MMSE method, tracking is efficient and speed is fast.

3. Review of Literature and Development in the Subject:

A **lane detection** system must be able to **detect** all manner of markings from roadways and filter them to produce a reliable estimate of the vehicle position relative to the **lane**. The Hough transform is a technique in which features are extracted that is used in image analysis and digital image processing.

3.1 B-Spline snake:

Snakes or active contours are curves defined within an image domain which can move under the influence of internal forces from the curve itself and external forces from the image data. Once internal and external forces have been defined, the snake can detect the desired object boundaries (or other object features) within an image. Snakes have been used widely in many applications, such as edge detection, shape modeling segmentation, and motion tracking. A more economical realization of snake can be reached by using far fewer state variables by cubic B-Splines. The B-Splines are piecewise polynomial functions that provide local approximations to contours using a small number of parameters (control points). It can represent curves by four or more state variables (control points). As required, the represented curves may be

open or closed. The flexibility of the curve increases as more control points are added. Each additional control point either allows one more inflection in the curve or, when multiple knots are used reduces continuity at one point.

3.2 Initialization of B-Snake lane model: CHEVP algorithm:

Some lane detection algorithms required the operator to provide the initial estimate of the road location, while others required the specific road structure scene (such as straight road) as the first road image. These requirements on the road initializations are clumsy for the automatic road detection task. Therefore, automatic initialization technique, able to extract the location of any type of the lane shapes, is important and necessary.

3.3 Description of the CHEVP algorithm:

The CHEVP (Canny/Hough Estimation of Vanishing Points) algorithm has been developed to meet these requirements. The road is assumed to have two parallel boundaries on the ground, and in the short horizontal band of image, the road is approximately straight. As a result of the perspective projection, the road boundaries in the image plane should intersect at a shared vanishing point on the horizon.

There are following processing stages in CHEVP algorithm:

1. Edge pixel extraction by canny edge detection. Canny edge detection is employed to obtain edge map.
2. Straight lines detection by Hough transform.

The detected edge points are used to vote for possible lines in the space of line parameters. The image is here partitioned into a small number of horizontal sections, , in order to accommodate the change in road vanishing point due to the bend of the road. The height of image section is gradually reduced as moving to the upper part of image. Notice that, each image section has its own space of line parameters, and edge points in each image section vote separately for possible straight lines in that section. By suitably thresholding the normalized accumulator spaces, line segments can be finally detected for each image section Horizon and vanishing points detection. The detected straight lines of each image section are paired, and the intersections of any pair of lines vote for vanishing points on another Hough space. This process is repeated for each image section separately, but vote in the same Hough space. The votes on each column of the Hough space are summed for detecting possible vanishing line. The row with the maximum support is chosen as the horizon in the image plane. For each image section, its vanish point can be determined as the point around the horizon and with the strongest support.

The CHEVP algorithm has been applied to real road images grabbed by a camera at different locations and at different times. These images include straight and curve roads with painted or unpainted, solid or dash lines, and shadow. Some results are shows the result of applying CHEVP to the images with the curved road. CHEVP locates the double paint line on the left side of the lane, and the white stripe on the right side of the road, especially it remains high accuracy in the near place to camera. The location of the detected mid-line is not totally accurate in the top of image due to the curve lines being hard to be detected by straight line parameters in Hough space. However, it is well within the tolerance necessary to use them to make initial predictions for the lane model detection.

Another example of applying the CHEVP algorithm to curve-road image with strong shadow edges. It can be observed that, even the white paint line on the right passes through noisy shadow edges, the Hough transform and the shared vanishing point constraint allow CHEVP algorithm to successfully locate the feature position. On the contrary, edge tracking algorithms would become confused by the shadow edges, which would offer multiple possible continuations. Shows the results of the CHEVP algorithm on the multi-lane image taken on a divided highway with strong shadows. As CHEVP algorithm is designed to choose the lane which is closest to the center column of the image hence, even under strong shadows, CHEVP algorithm successfully locates the solid white stripe on the left side of the lane, as well as the broken white stripe on the right side of the lane where the vehicle is located.

The road image was taken on a 1-lane road for bicycle. It can be seen that the road is wet after raining. The CHEVP algorithm can only detect the vanishing points. However, the estimated midline of road is still acceptable. The CHEVP algorithm shows promise to provide a robust method for extracting and identifying the lines composing the road, with an ability to reject 'weak' local optimality in an image. Moreover, the parameters of camera are not required. Being initialized by CHEVP, the B-Snake would deform to lane boundaries more precisely by using MMSE (Mini-Mental State Examination) approach. CHEVP algorithm assumes that the horizon (or vanishing line) appears horizontal in the image plane, although it need not be in the camera's field of view. If the terrain varies in slope, CHEVP algorithm may be unable to correctly locate all the road lines due to their not having a vanishing point on the horizon row corresponding to the tangent plane at the vehicle location. However, CHEVP algorithm has ability to identify the best horizon row and vanishing point for each section of the image, but it would lead to a 3D road model.

Yue Wanga , Eam Khwang Teoha and Dinggang Shenb worked on this topic and he conclude that a novel B-Snake based lane model, that describes the perspective effect of parallel lines, has been established for generic lane boundaries (or markings). It is able to describe a wider range of lane structures than other lane models, such as straight and parabolic models. The problems of detecting both sides of lane markings (or boundaries) are merged here as the problem of detecting the mid-line of the lane. A robust algorithm, called CHEVP, is presented for providing a good initial position for the B Snake lane model. This algorithm is robust against noise, shadows, and illumination variations in the captured road images. It is also applicable to the marked and the unmarked, as well as the dash and solid paint line roads. To approach the lane edges based on the initialized location, a minimum error method, MMSE that measures the matching degree between the model and the real edge map is presented to determine the control points of road model for lane detection and tracking. In this method, dual external forces are sampled along the B-Spline and comprehensively transmitted to each control point for its update by minimizing both the sum of the external forces and the difference of horizontal components of external forces on the two sides of the road model. The obtained results are quite good and accurate under various conditions. In this part they mainly focused on 3D lane model.

4. Aim and Objective of Research:

1) To study lane detection using CHEVP Algorithm or other Similar Algorithm.

2) To Study different types of lane boundary detection Specially B-snake lane for safety uses for Drivers to minimize accidents.

3) It is necessary to update B-Snake to minimize the sum of the external forces from the both sides of the road model for achieving accurate position of B-Snake

5) CHEVP is presented for providing a good initial position for the B-Snake.

5. Methodology:

Methodology will include the following steps:

1) To refer relevant reference books on lane boundary detecting by various Possibilities.

2) To carry out survey of latest modified technique used for lane detection.

3) To refer and study the Past research on Lane boundary delectation and analyze and modified.

4) To use CHEVP Algorithm and Mathematical Software for finding the Images and best result.

5) To use Hough transform for the straight line detection as per need.

6) To use Algorithm Based on Vector Fuzzy Connectedness.

6. Importance of study/ Society application:

1) Gives assistance and details to pedestrians and drivers.

2) Uniformity of the markings is an important factor in minimizing confusion and uncertainty of drivers about their meaning.

3) Allows vehicular drivers to drive safely.

4) This algorithm is proposed without using camera.

5) This method is to track the road lane markers of various shapes (curved or straight) and locate. Precise lane marking points on each horizontal and other low illumination condition.

6) Suitable for Specially B- Snake roads.

7. **Proposed work Plan/ Formulation and Structure of Study:**

1st Year	**1.** Literature Collection.
	2. Reference book on Lane boundary detection Technique.
	3. Study Different types of Methods to Reduce the error.
	4.Submission of Progress Report
	5.Start experimental test
2nd Year	**1.**Detail study
	2.Compilation of data
	3. Preparation of Research Papers and publishing in national and international Conferences.
	4.Submission of Progress Report
3rd year	**1.**Use of CHVEP and Mathematical Software's
	2.Preparation of Images
	3.Data Interpretation
	4.Data Preparation of Research Papers & Communicating it for Publication
	5. Report Writing Submission of Final Thesis.

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